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CONTENTS.

MEMORANDUM REGARDING THE MYCOLOGIST'S TOUR IN CACHAR AND SYLHET TO STUDY SEED GARDENS—MAY 1915.

The primary object of this tour was to learn whether any particular fungus diseases were responsible for the alleged deterioration of tea seed gardens in Cachar and Sylhet, and, if such were present, to devise means for their eradication; and secondly to consider how the condition of seed gardens in general could be improved.

Although many of the diseases which commonly affect tea bushes were found to be doing their share of damage, it was apparent that any deterioration there may have been was due for the most part to the general treatment which the average seed gardens receive. The ways and means of improving the methods at present employed were therefore studied. When cultivation, manuring, and plucking are well carried out, it will be time to pay particular attention to the treatment of the diseases which survive the improved conditions. This report, therefore deals with preventive rather than curative treatment of seed gardens.

The tea plant flowers twice a year and produces most of its fruit on the previous season's wood. The flowering shoots bear three buds in the axils of their leaves. The two outside buds are flower buds, the centre one is a leaf bud. Whether the flower or the leaf buds develop depends on circumstances over which the planter has some control. Frequently one flower bud will produce two flowers. The flowers are generally fertile but many of the young seeds fall off. The heaviest crops of seeds are produced on healthy trees growing on well-drained but moist soil, in situations sheltered from the dry winds but freely exposed to light and air. As a rule the bushes give large crops in alternate years.

Pruning of tea seed bushes.

The pruning of tea plants grown for seed is a very different thing from the pruning of tea bushes for leaf. The methods

adopted in carrying out the latter operation have been developed as knowledge has increased, and they are now carried out in the best practice strictly in accordance with well understood and recognised botanical principles. The treatment of seed bushes however in this regard is at present unsystematic, not to say ill or un-considered, and so little pruning of seed bushes has been carried out consistently on any system that there is but little experimental evidence in favour of one rather than another method. The objects aimed at in pruning any tree grown for fruit or seed are:—

(1) to prevent damage to branches by each other, and to space out the branches so as to give each one sufficient air and light for its full development as a seed carrier.

(2) to equalize the annual crops. There is a natural tendency for the size of seed or fruit crops to vary considerably year by year, very often the size of crops being of the same order in alternate seasons and differing in the intermediate seasons.

(3) in the case of marketable crops, to produce a smaller number of individual fruits, each individual being of superior quality as regards size &c.

(4) to reduce the tendency to disease by limiting the growth to vigorous branches.

Shape of seed tree.—This matter is not immaterial, and it is probably advisable to control the height and shape of seed trees so as to obtain a bush bearing half a dozen or more strong branches arising from a single stem a foot or more from the ground. If these branches are chosen so as to space out the bush properly, each will receive its full share of air and light. The tree when full grown would be about 12 feet in height and the diameter of spread about 15 feet.

The advantages of this shape are that:—

(1) It gives a much greater bearing area than a single stem plant.

(2) It covers the ground and protects it from the direct rays of the sun and from drying winds.

(3) It is convenient to treat with spray fluids, &c.

The natural habit of the tea plant is to grow straight up, and it may be found advisable to tie the branches, so that they are less vertical in direction, for some years until they remain in the position desired, but by shortening back the young plants for the first few years the spread may be increased until the plants are of the proper shape. Having obtained the desired form the next thing is to keep it. In doing this other important points must be considered. First of all it should be remembered that most of the seed is produced on the previous season's wood, and if the next year's crop is to be a good one, sufficient of the last season's wood must be retained on the tree.

Cold weather pruning.—Once the correct shape has been obtained, the only pruning which will be necessary in the cold weather will be the thinning out of shoots which have produced seed in the previous season and spacing out those for the next years crop. Severe pruning, either by removal of many shoots or by drastic cutting of older branches, should be avoided as much as possible as it tends to stimulate the formation of vegetative growth and hence interferes with the flowering. The best time to prune in the cold season would appear to be about the time the seeds are collected. At that time there are but few young seeds or flowers likely to be damaged during the pruning.

Rains pruning.—Important pruning work may be done in the growing season. Shoots which arise on the flowering stem during the fruiting season rarely become productive but usually remain twiggy, weak and thin. Such shoots are much better pinched off. If they are allowed to remain they interfere with the nourishment of the seeds, and yet at the end of the season have to be pruned off. The postponement of their removal serves no good purpose. It is therefore recommended that much superfluous growth be thinned out during the growing season. If this rains pruning be commenced too early in the season it may cause the production of twiggy laterals, and it would perhaps be well to defer it until July or August, when the spring growth will have practically ceased. It will readily be understood that the effect of rains pruning will in

all probability not be apparent until the next growing season, and it should be remembered that while winter pruning tends to increase the vigour of such branches and shoots as remain on the tree, summer pruning, by reducing the number of growing leaves, tends to weaken the tree.

Fruit.bearing is associated with a quiescent rather than a stimulated, fitful condition, hence heavy pruning should be avoided as far as possible. During the first few years after planting out, or after collar pruning, the plant should be trained to the form desired, and all subsequent pruning should not be severe, but methodical and regular.

Renovation of old seed trees.—In many cases seed gardens have been allowed to get into such a state that drastic treatment is necessary to bring them into good condition again.

It is frequently necessary in the case of seed trees, as of plucking bushes, to cut right down to the collar and build up a new plant according to some definite plan. It will probably take three or four years before the tree is properly formed again after this treatment and may be expected to bear seed. In the years immediately after that of collar pruning attention should be paid to obtaining the requisite spread and a properly spaced-out bush. Once the tree is the required shape no more heavy pruning should be necessary, and a system of light pruning in both summer and winter should be all that is required.

The distance apart.

Most of the tea seed trees in the gardens visited were planted much too closely—five feet by five feet and six feet by six feet having been frequently seen. Such seed gardens may have produced good crops in their early years but in most cases have subsequently deteriorated considerably. Observations of individual plants, which have obtained more room by the accidental death of surrounding trees, shows conclusively that wider planting is desirable, sixteen to twenty feet being reasonable distances. The number of plants per acre should be reduced on gardens which have been planted too thickly. The plants should be dug out completely and not cut down and used for plucking. When plucking bushes

are grown in the shade of the seed bushes the results are almost invariably unsatisfactory. If the bushes are too close together the superfluous bushes should be dug out before an attempt be made to reform the remaining ones. In many cases where the bushes have been formed badly it is advisable to collar prune and build up the frame work from the ground.

Cultivation.

In most cases the cultivation was inadequate judged by the amount of cultivation given to fruit trees. The shade of the trees generally keeps down the weeds, and hence the necessity for cultivation is not so apparent as it is in the plucking area. It should however be pointed out that cultivation is needed to aerate the soil and promote chemical changes, so as to render food substances available for the use of the plant, as well as to keep down jungle.

Green manures.

The lack of organic matter in many of the soils was apparent and green manure crops should be sown so that they will be ready for hoeing in three or four weeks before the time for the collection of the tea seed. By hoeing the crop in then the bushes would obtain the maximum benefit just about the time the seeds are ripening, hence leading to the production of a greater percentage of heavy seeds, and also, by leaving the surface soil at the conclusion of the rains in a light friable condition, tending to conserve moisture during the cold season. The best crops to use will differ with circumstances. On flats Mati kalai, Cowpeas or Dhaincha or any other quick growing crop may be used as best suits the soil, but on hill sides there are other considerations which might well be taken into account, and by a judicious selection a green manure crop may be used to prevent wash as well as provide organic matter. All steep slopes should be planted at the beginning of the rainy season with a crop which will grow throughout the rains and yet not attain to a height which will interfere with the growth of the tea plants. It may then be hoed in as described above.

The following are suitable plants for this purpose :

Tephrosia purpurea,

Leucaena glauca,
Clitoria cajanifolia,
Desmodium polycarpum.

The latter plant is very commonly found in the jungle round about tea gardens. It is described in Part I of this year of the Quarterly Journal. All these plants may be propagated from cuttings, and this method may be found most useful especially in the case of plants which have very small seeds. In the case of plants like *Clitoria cajanifolia* or *Desmodium polycarpum* their trailing stems may be pushed into the soil at intervals. They will take root after they are so layered thus forming a dense network across the face of the slopes, which can be satisfactorily alternated with bunds to prevent wash.

Manuring.

The manuring of tea-seed trees is a matter which has not yet received proper attention. It is not sufficiently widely understood that in the formation of seed and fruit the mother plant elaborates and stores up for the use of its offspring a concentrated supply of food-material, the actual location of which differs in different seeds and fruits. In the case of tea seed this is chiefly found in the cotyledons. The amount of mineral substances and nitrogen in seed is greater than in a given weight of leaf. As is well known the material left, after expressing oil from such seeds as contain it, is richly nitrogenous and a valuable manure. It is therefore necessary in manuring seed gardens not only to consider the purpose to which manures may be put in maintaining a good tilth of soil and promoting general vigorous growth of the bushes, but also to provide an ample supply of those substances which are required to build up the food reserves in the seed. In devising manurial mixtures for this purpose excess of readily available nitrogenous substances is usually avoided and an ample supply of phosphoric acid and potash in a readily available form is given. Examination of analytical figures of soils which have reached us from certain gardens has shown clearly that poverty of the soil alone may be put down as a cause of the recent failure on the part of the bushes to develop a satisfactory amount and quality

of seed. It is therefore very necessary that the first step to be taken in devising means to renovate seed gardens is to make oneself acquainted with the composition of the soil. The officers of this Department are very ready to help in interpreting figures of analyses made for this purpose.

Harvesting the crop.

Seed should never be allowed to remain on the soil under the trees for any length of time, but should be collected and sorted properly with as little delay as possible. Opinions differ as to the best way of storing seed but one thing is certain, that it should be kept under fairly constant conditions of temperature and humidity. If it be allowed to dry it is liable to lose its power of germination, especially if it be subjected to varying conditions of moisture again before packing. The best conditions for storage of tea seed have not been studied by this Department, but a translation of an article published in Java which has some bearing on this question has been published in Part I of 1914 of the Quarterly Journal.

The Treatment of diseases of tea seed gardens.

With the exception of the tea seed bug the diseases which attack the seed trees in North East India are the same as those which attack the tea bushes grown for leaf. Red rust (*Cephaleuros virescens*) and die-back (*Gleosporium*) are particularly prevalent on many gardens but both these disappear, or at any rate their attacks become insignificant when the trees are otherwise healthy. A system of spraying may however be introduced with advantage, partly with the object of reducing pests and blights, but more particularly as a tonic. The bark of seed bushes is as a rule covered with lichens and other epiphytes. These check the expansion of the stems. Every year the stems increase in girth, and unless the bark be allowed to stretch or crack the growth is interfered with. These plants on the bark should be removed, and the best way to do so is by washing or spraying with a caustic solution in the cold weather. Details of such solutions will be found in a recently published pamphlet (Notes on the Spraying

of Tea). The bushes should also be sprayed with lime sulphur or Bordeaux emulsion in dry weather about April or May, and again in September. This rains spraying would reduce parasitic fungi and be affective against many insect pests besides increasing the vigour of the plant. The best known remedy for the tea seed bug is catching. The insect is fairly easily caught and the cost of its eradication would be considerably lessened if the trees were pruned to a convenient shape in the way suggested above.

Loranthus.

The epiphytic plant which is popularly called mistletoe or rogamulla is found in most tea seed gardens and its presence shows that under the present system of pruning it is impossible to supervise the tree properly. If the trees were planted far enough apart and pruned in a satisfactory manner the mistletoe would not require any special measures for its eradication. A little of it may be introduced every year by birds but it would be removed before it grew big enough to be harmful. It may interest planters to know the exact manner in which this plant is propagated. The fruit is eaten by birds and the seeds after passing through their alimentary canals are deposited on the leaves and stems of plants. Certain birds are especially good distributors of such seeds as they always turn sideways when evacuating, thus depositing their excreta on the branch on which the bird is standing.

Hail.

Seed trees are frequently injured by hail and a great many trees are permanently disfigured. The effect of a severe hailstorm is frequently similar to that produced by heavy pruning *i.e.* it stimulates the production of vegetative growth and therefore interferes with seed production. Fungi and white ants frequently augment the damage done by the hail. When seriously damaged the trees should be sprayed thoroughly with Bordeaux mixture as soon as possible after the storm. This will prevent infection and help the callus to form over the wounds. Application of potash manures is also advised *e.g.* nitrate of potash. Summer pruning in July or August would considerably help in

reducing the effect of the injury on the fruiting of the tree in the following season. It would however, while tending to prevent the formation of leafy shoots, weaken the tree slightly at the same time.

The deterioration of seed gardens has in most cases been due to lack of knowledge, or neglect of study and application of the principles of growing trees for their fruits. In one or two cases where planters have treated seed gardens carefully the trees themselves are healthy and vigorous, but the crop is irregular or produced chiefly in alternate years. This is the case with many fruit trees when the pruning has not been done properly.

Briefly the suggestions we make are as follows :—First of all a tree of convenient shape should be formed, and any subsequent treatment likely to disturb the equilibrium of the plant should be avoided. The treatment of plant diseases in tea seed areas is not more urgently required than in the plucking areas. At the present time there are greater difficulties in the treatment of the former by reason of the inconvenient shape of the trees. When this is remedied, as it most certainly will be in the near future, the application of spray fluids may be added to the general routine without any special effort. Even under the present conditions spraying on the lines suggested above would be profitable To obtain the best results seed trees must receive more individual thought and attention,—as much care if possible as is bestowed on individual trees in a fruit orchard. It would be profitable to do so. The profits per acre of a tea seed garden with a good name on the market are surely large enough to warrant this. In the case of estates where small seed gardens are maintained for seed for local use, it would be better to confine attention to comparatively few trees, and by improving them realise the same crop as is obtained under present conditions from a larger area.

EXPERIMENT TO DETERMINE THE MOST SUITABLE DISTANCE APART FOR PLANTING IN NURSERIES.*

If seedlings from nurseries are to be transplanted in a new clearance at 6 months old, the general practice is to plant the seed in the nurseries 6 inches apart; for the small plants produced at this age, this gives sufficient room for development, and may be considered to give satisfactory results.

When the seedlings are to be transplanted at a year old or more, which is frequently done in clearances and is usual for infillings, wider planting appears desirable, and these experiments were undertaken to obtain data on this point.

Two kinds of seed were used, both of a light-leafed Assam type; one Singlo once-removed seed from Khorikutea, the other jungle seed from Dibrugarh. The seed was germinated in pits in December 1912, and planted in February 1913 in land previously grass jungle. The plots, previous to planting, were manured with lime at the rate of 1 ton per acre, and cattle manure at the rate of 20 tons per acre. In February 1915 the plants were dug up, measured and weighed. The results are shown in the accompanying table. The height was measured from ground level to tip; and the circumference at the ground level. The weight is that of the whole plant including the root.

	Distance apart of seedlings. inches.	Average weight of 100 plants.	Average height inches.	Average circumference. inches.
Dibrugarh jungle seed ...	4	42	44	1·12
	6	57	50	1·43
	9	79	44	1·70
	12	90	39	1·86
	18	124	43	2·31
Khorikutea seed ...	4	44	71	1·17
	6	55	49	1·54
	9	86	50	1·90
	12	106	47	2·20
	18	132	38	2.08

* This experiment was carried out at the Tocklai Experimental Station.

An inspection of the plants as they were growing showed that the closest-planted beds had the appearance of greatest height and that the height regularly decreased with the width of planting, with the exceptions of the beds planted at 18 inches where growth was very irregular.

Though the closest-planted beds contained the highest plants, actual measurement showed (as shown in the table) that the closer planted seedlings sometimes had a lower average height than those in a more widely planted bed. This was because the closer planted beds contained a large number of very poorly developed short plants which lowered the average. The average diameter increased fairly regularly with the distance apart of planting, the only exception being the Khorikutea seedling planted at 18 inches. These seedlings planted at 18 inches can be taken as extreme examples of the alteration in habit of growth produced by wide planting, the plants being of a bushy character with many thick, spreading low branches. Close planting on the other hand tends to produce a tall thin plant with few or no low branches and with straight deep taproots.

For infilling, for which the plants employed are not usually less than a year old, it is generally considered important to obtain a plant high enough to be seen above the surrounding tea when planted out, the usual procedure after that being to leave it unpruned until a thoroughly vigorous young plant has been formed which will come away quickly when it is cut down.

Sufficient height being obtained the maximum thickness of stem should be aimed at, and it has been pointed out above that this is produced by wide planting.

It must be remembered that the area required for the nursery increases very rapidly with increase of distance apart of seedlings as is sown in the following table :—

Distance apart of plants.	No. of plants per null.	No. of nulls necessary for 1000 seedlings.
4 inches	1396	·716
6 „	576	1·736
9 „	256	3·906
12 „	144	6·944
18 „	64	15·625

On the other hand if the planting is too close, seed is wasted; for even assuming that all the plants are well enough developed, many plants will have to be left, if a good "bheti" be taken. Thus, if 4 inch planting were used, every alternate plant would probably be wasted.

Taking everything into consideration it would appear that the width of planting best suited for the purpose is not less than 9 inches, and not more than 12 inches. Between these limits the choice will be dependent on the kind of seed and soil.

For cleatances, the choice between these distances of planting, on which the shape of the seedling, tall on the one hand or bushy on the other, is dependent, should be decided on the experience of the growth and habit of seedlings in the particular district. If the most satisfactory practice is to allow seedlings first to grow without check and then, when the stems are about an inch in diameter, to cut them to say 2 inches from the ground, the tall form of seedling is probably most suitable, but planting of seed for the purpose should in no case be less than 9 inches apart and might with advantage be 10 inches. If on the other hand it is found by experience that the bushy type of seedling forms eventually a satisfactory root growth with a deep straight taproot and can be pruned soon after planting out in such a way as to produce vigorous laterals from low down on the stem, then the seed should be planted at 12 or more inches apart so as to produce seedlings of the best shape for the purpose.

G. D. H.
H. R. C.

EXPERIMENT TO DETERMINE THE EFFECT OF LIME ON THE GROWTH OF TEA SEEDLINGS.

In this experiment Singlo seed (once removed) from Khorikutea, and a jungle seed from Dibrugarh were used.

Both the limed and the check plot were given cattle manure at the rate of 20 tons per acre. This provided nitrogen at the rate of 314 lbs. per acre, potash at the rate of 184 lbs. per acre, and phosphoric acid at the rate of 112 lbs. per acre.

The seedlings were therefore well supplied with the necessary plant foods in both cases, and any difference observed must be ascribed to the effect of the lime on the soil.*

The limed plots received slaked lime (containing 51% calcium oxide) at the rate of 1 ton per acre.

The results obtained are shown in the table.

In the case of the Dibrugarh seed a very marked improvement in every direction was shown by the limed seedlings; but in the case of the Khorikutea seed there was not such a marked increase either in height or circumference, nevertheless the plants on the limed plots were much healthier in appearance, the increase in weight being due to a greater production of leaves and branches. This increase in weight, it will be noticed, was very marked in each set of experiments.

DIBRUGARH JUNGLE SEED.

	Weight of 100 plants.	Average height in inches.	Average circumference in inches.
Manured with cattle dung and lime ...	79 lbs.	44·5	1·63
Manured with cattle dung only ...	53 lbs.	34·8	1·55
Increase over check plot ...	49%	28%	5%

* This experiment was carried out at the Tocklai Experimental Station, the soil of which is known to require lime. Different results might be obtained on other soils.

KHORIKUTEA SEED.

———	Weight of 100 plants.	Average height in inches.	Average circumference in inches.
Manured with cattle dung and lime ...	77 lbs.	46·6	1·83
Manured with cattle dung only ...	63 lbs.	43·8	1·78
Increase over check plot ...	22%	6%	3%

G. D. H.
H. R. C.

RECENT TOURS.

Chief Scientific Officer.

On the 13th of April the Chief Scientific Officer left Calcutta for Sylhet. He first visited the Lungla and Juri sub-district and met several planters at the Lungla Club on the 18th, having previously visited several gardens in the Lungla Valley. On the 19th he left for the Juri Valley and left this sub-district on the 22nd for the Longai Valley.

Several gardens in the Lungla Valley have red soils which only require careful treatment to be converted into soils of excellent tilth. The two things which have been neglected in the past are the prevention of wash and the growth of green crops to provide organic matter. If attention be paid to these operations, to manuring with top dressing soil where obtainable near at hand, and with artificial manures and line manure in other cases, the fertility of the soil might be greatly increased.

Other soils, some of a type often seen in rice fields, and others approximating to bheel soils are of frequent occurrence in the Lungla Valley. The treatment of these soils and the work necessary to renovate them when once they have deteriorated, are matters which require the greatest care and thought, and trial of every form of treatment likely in theory to be successful and to be possible in practice should be made.

In these soils the vitality of the bushes appears to be less than on the red soils, the reason probably being that, owing to faulty conditions of drainage or tilth or both, the bushes probably often suffer from temporary starvation. Heavy manuring with artificials appears to effect marked improvement, and experiments should be made in order to determine the most economical manures to apply and the most suitable quantities.

An interesting experiment was seen on a garden in the Lungla district where terraced tilas are being weeded in the rains and hoed

only in the cold weather. The suggestion was made that selective weeding should be resorted to on the faces of the terraces, so as to eliminate obnoxious weeds and allow only those to remain which are found most suitable for the purpose of binding the soil.

A demonstration was given on the same garden of a form of pruning suitable for young plants, the principle of the pruning being that of cutting centre lower than outside branches.

In the Juri Valley the red tilas are a marked feature of the landscape, and the soil of these tilas, where it has not suffered from wash, is undoubtedly good, and the conditions affecting the supply of plant food superior to that which generally obtains on the flats.

On the 21st of April the Chief Scientific Officer left the Juri district for Longai, visiting this district for the first time. The most interesting feature of this and the Chargola sub-district, which was next visited, is of course the bheel. The practical and scientific problems on soils of this kind appear to be apart altogether from those of plateau and tila gardens. Pruning of bheel gardens is notoriously bad from the theoretical point of view, and deteriorating bheel bushes are the worst offenders that can be found in respect of bad wood. The bheel soils undoubtedly are more prone than others to temporary conditions which result in starvation of the bushes, rich though the soils themselves appear on analysis. Under these conditions branches are likely to die and once deterioration of individual branches has set in damage to any part of the frame of the bushes may follow. Bad pruning has aggravated this tendency, and the state of affairs is at present that the bushes which require, for the above reasons, to be pruned more correctly than any others are less carefully attended to. The remedy appears to lie not in attempting to carry out at once in their entirety all the more careful and more scientific methods adopted elsewhere, but for planters to grasp one or more correct principles and to get them applied gradually as far as possible in practice. To give an illustration, single branches which show signs of decay should be removed entirely down to a point below the

damaged part and always at a junction with another branch so that no snag is left. This can be done diligently with respect to every damaged branch of every bush, or occasionally on a few bushes on a section which requires it, as occasion and labour offer, but let the correct method once be established, the benefit of it will then be seen, and the advantage of extending operations on these lines will be realised.

There are certain facts noted in practice in connection with bheel which cannot easily be explained but which seem to be generally agreed upon. They are recorded here now for future reference when this Department is in a position to take up the detailed study of one or more of the problems involved. Firstly, in connection with pruning it appears that on deteriorated bheel tea the only methods of pruning at present carried out,—because they appear to be the only ones which bushes will stand—are (1) ordinary light pruning, which here is nothing more nor less than cutting off, with a sweeping stroke of a slightly curved knife, of the years growth, leaving about an inch of new wood ; (2) a beech kalam, which is the method resorted to when bushes get too high or begin to deteriorate. Most bheel bushes have never been cut low when young, and consequently this beech kalam reduces the width considerably unless it be made fairly high. General opinion holds that if it be made lower than say 18 inches a very large percentage of bushes die. The reason for this merits enquiry and experiments might be made by managers of bheel gardens in the following directions :—

(1) In cutting young tea low :

(2) In reducing the height of bushes by light medium pruning, combining this with removal of a certain number of branches lower down in the correct way (see " Some aspects of modern tea pruning ") so as to space out the branches, foster laterals, prevent congestion of the centres, and remove bad wood.

Another interesting feature of fluffy bheels is their deterioration. The results of this deterioration make themselves felt in the bushes, which show all the appearance of starvation. Great

open cracks appear in the soil and the formation of a dry powdery condition of the soil takes place, which becomes more aggravated with time until finally the soil becomes non-absorbent of moisture, and even after heavy rain moisture does not penetrate more than a few inches. It has been suggested that the latter phenomenon is due to the accumulation of a wax-like substance, which has been known to occur in soils in America. It is apparently difficult to deal with. The following is a quotation from a recent book on soils relative to this matter :—

> "Some of the soil organic matter is wax-like in properties, "interfering very much with the wetting of the soil and "the movement of the water. As it only decomposes "slowly it tends to accumulate in rich soils and to be "rather troublesome. It can be extracted by organic "solvents e. g. toluene, and obtained as a yellowish "brown mass containing appreciable quantities of "nitrogen (A soil yielded '003% of a substance con- "taining 3% of nitrogen in one of the writer's analy- "ses)."

Another remarkable fact which is generally recognised, but which I am not able to explain, is the great value of dressings of cattle manure on fluffy bheels.

Entomologist.

During the month of April an advisory tour was carried out in the Golaghat, Nazira, and Sonari sub-districts of Assam. The tour was commenced on the 6th of the month, on which date an address was delivered at the Golaghat Club, attended by ten planters. The roads were in very bad condition, after heavy rain, but the Entomologist was able to visit the Woka, Rangajaun, Hautley, Numaligarh, Behora, and Negheriting estates while in the district. The Nazira sub-district was reached on the 14th, and on the evening of that day an address was given to nine planters at the Nazira club, after which visits were paid to Bamonpukri, Mohokotie, Dooma Dullung, Gelakey, and Mackeypore Tea Estates. From Nazira the tour was continued to Sonari, which district was visited during the period 20th to 24th. The

Napuk, Suffry, Towkok, Tinglibam, and Jaboka estates of this district were visited, and an address was given before twenty people at the Sonari Club, on the evening of the 21st.

The above three districts are remarkably free from insect injury, and tea garden managers had very few insect pests to show. Crickets were in evidence in some places, and on one garden young cut-down tea had suffered severely from the attacks of these pests. On a garden in the Golaghat district peculiar marks were observed on the older leaves. Each mark consisted of a central black spot surrounded by a pale area, the outer diameter of which was about a twentieth of an inch, and in many cases the marks were in lines. Examination of these marks gave evidence of their being punctures made by some sucking insect, and a homopterous bug belonging to the genus *Tettigoniella*, which was present in the tea in large numbers, was suspected. Specimens were accordingly put into a breeding cage and provided with tea shoots, when they were observed to suck both the steams and the leaves, producing marks similar to those found in the tea. Large numbers of a small black weevil were observed on Boga medeloa in the districts under discussion. These weevils eat the epidermis of the leaf in patches, giving the surface a blotchy appearance, but the damage done does not appear to be of much moment. Most of the gardens visited were observed to be suffering from apple foliage blight, some seriously.

Mycologist.

The Mycologist made a special tour in Cachar and Sylhet to investigate the alleged deterioration of the tea seed gardens in those districts. Leaving Tocklai in the beginning of February he toured Sylhet, proceeding to Cachar in the beginning of March. He returned to Tocklai for a few days in the middle of March, setting out for North West Cachar towards the end of the month. The tour was completed at the beginning of April when the Mycologist went to Calcutta, returning to Tocklai later. A memorandum of the observations made during the tour will be found elsewhere in this journal. Although the visits to individual gardens were necessarily very brief, the Mycologist had the

opportunity of meeting many planters and discussing the various blights of their respective gardens with them. Their keen interest in the mycological work made the tour a very profitable and pleasant one.

During the 1st week in May the Mycologist paid a short visit to North Lakhimpur to study the influence of certain soils on root formation.

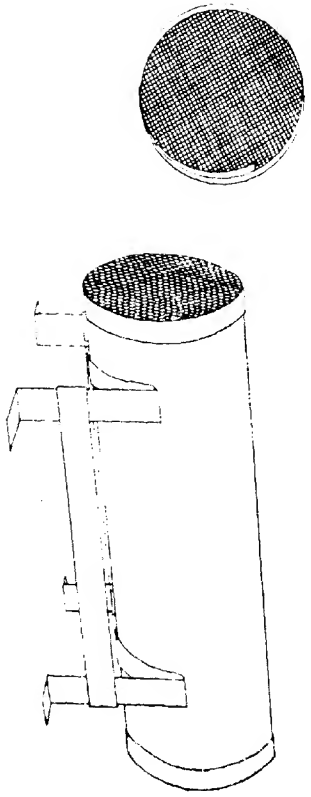

Fig. I.

NOTES.

Breeding cages for insects.—Advice having recently been sought by interested planters on methods of rearing insects in captivity, it may not be out of place to give a description of two simple breeding cages which can be readily constructed by any one wishing to rear insect pests. Both cages have the advantage of being easy to make from materials which are always ready to hand, and are at the same time of such a construction that the insects are very easily observed.

The first type of cage has been found very useful for rearing leaf-eating caterpillars. It is made from an ordinary cylindrical lamp chimney, provided with a gauze cap at each end, and its construction will be readily made out by reference to figure 1. Any size of chimney may be used, according to circumstances, but the one which has been found to be most generally useful is about ten inches long, with a diameter of two and a half inches. To make the cap a strip of thin metal half an inch wide is bent into a ring which just fits over the cylinder, and the end soldered. A piece of wire guaze is then soldered across the opening of the ring, and a small strip of thin metal, about an inch and a half long and three-eighths of an inch wide, is soldered by one end to the inside of the ring to act as a spring, which clips the cylinder firmly and prevents the cap from falling off. The stands are made by the laboratory mistri of hoop iron taken from packing cases. The gauze caps may, if so desired, be replaced by muslin or mosquito netting held in position across the ends of the cylinder by means of india rubber rings.

The second type of cage is primarily designed for rearing sucking insects on small plants. It is made from a large wide pear-shaped lamp chimney or globe (the globe of a hurricane lantern would do), which rests in a metal cylinder (see figure 2). This metal cylinder consists of two cylinders of sheet metal of the same diameter, each about two inches long, joined end to end by a

strip of perforated gauze soldered to a rim of each cylinder. The top of the glass globe is closed by a gauze cap or by muslin. The cage is placed over the plant and the bottom rim of the metal cylinder pressed about an inch into the soil.

The duration of the action of manures*:—The following results are extracted from a detailed account, in the Journal of the Royal Agricultural Society of England, of a set of experiments by A. D. Hall at Rothamsted. The experiments extended over 9 years. The tables below show the relative produce of the manured plot, the unmanured check plot being taken as 100.

NITROGENOUS MANURES.

	year of application.	1 year old residue.	2 year old residue.	3 year old residue.
	Mean of 9.	Mean of 8.	Mean of 7.	Mean of 6.
Shoddy	139·7	125·2	116·1	106·7
Peruvian Guano ...	150	101	96·5	94·4
Rape dust ...	136·2	100·4	100	94·4

The shoddy evidently contains nitrogen compounds which very slowly decompose in the soil to yield compounds available for plant food. In the course of 4 years an increase of 88% over the check plot was obtained; but of this total effect less than half was shown in the first year, while in the fourth year some effect was still showing.

With both Peruvian guano and Rape dust the full effect was obtained in the first year, and there was little or no residual effect even in the second year. The nitrogen compounds in the guano are mainly ammonium salts, and uric acid and its derivatives; while in the rape dust the nitrogen is almost entirely present as proteins, and it is a point of great interest to note that the proteins are as quick acting, and as little lasting in effect as ammonium compounds.

It is a matter of general experience that cake and fish guano are more immediate in their action than meat guanos, and the

* Reprinted from the Monthly Bulletin of Agricultural Intelligence and Plant Diseases. Rome, December, 1914.

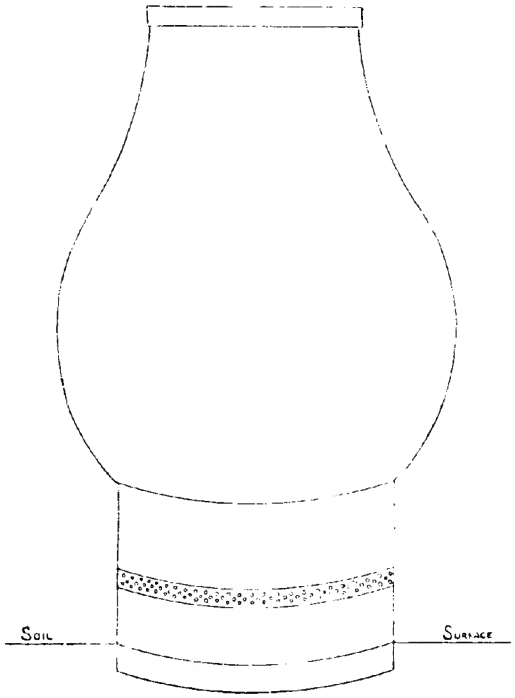

Fig. II.

above experiments provide an explanation; for in the cake the nitrogen is present as proteins, and in the fish-manure mainly as proteins, while the meat manures contain both proteins and collagens (the insoluble nitrogen compounds of wool, bones, &c.), and the proportion of collagens increases as the meat-guano approximates to a bone-meal.

The above results apply only to the nitrogenous constituents of these manures and not to the phosphates contained in them.

PHOSPHATIC MANURES.

Results with phosphatic manures are given in the following table :—

	year of application.	1 year old residue.	2 year old residue.	3 year old residue.
	Mean of 9.	Mean of 8.	Mean of 7.	Mean of 6.
Superphosphate ...	116·2	109·1	113·8	107·8
Bone-meal ...	114·6	112·4	109·1	105·6
Basic slag ...	114·5	110·5	104·8	112·0

These results are mainly interesting as showing how the effect of a dressing of a phosphatic manure is spread over a number of years; and as showing that superphosphate is nearly as lasting in effect as basic slag or bone-meal.

It should be noted that these results were obtained on a soil well supplied with lime, and it is possible that somewhat different effects might be obtained on soils, which, like the great majority of tea soils, are very poor in lime.

It has generally been observed, however, that basic slag for example, is no slower in action than superphosphate on these acid tea soils.

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* **Investigations on the manufacture of tea.**—Sawamura, S., in The Bulletin of the Imperial Central Agricultural Experiment

[a] Reprinted from the Monthly Bulletin of Agricultural Intelligence and Plant Diseases, Rome, January, 1915.

Station, Japan, Vol. II, No. I, pp. 75-83, Nishigahara, Tokio, March, 1914.

I.—*Effect of steaming on the activity of the enzymes of tea leaves.*—Tea leaves contain an abundance of oxidising enzymes which produce a black colour during the fermentation. The destruction of these oxidising enzymes by steaming results in a green tea.

Among other enzymes in tea leaves is diastase, which may be extracted in 40% alcohol and precipitated in ether-alcohol.

By subjecting various samples of tea to steam for different periods and testing for oxydase, the writer found that the oxydase loses its activity when steamed for 30 seconds, but retains its diastatic power. It is therefore very probable that enzymatic action takes place in the first stage of rolling tea leaves and that the production of a fine aroma is due to this.

II.—*Effect of rolling on the solubility of tea.*—The object of rolling the leaves in the manufacture of green tea has not yet been determined. It may be to give the tea a fine shape, or to press out the juice to accelerate drying, or to break the cells in order to increase the solubility.

Samples of green tea were prepared with and without rolling and the qualities of their infusions compared.

The infusion of the rolled tea was of a deeper colour, and had a stronger flavour and better taste than that of the unrolled tea.

The difference was also apparent in the amounts of soluble matter in the infusions, which were as follows :—

	Percentages of the total amounts of each constituent in the original samples.	
	unrolled (Tencha).	rolled (Gyokuro).
Dry matter ...	23·021	31·656
Nitrogen	31·869	34·427
Tannin	8·216	34·374
Caffeine	63·559	79·453
Ash	64·083	63·708

These differences in the amounts of soluble matter in the infusions of rolled and unrolled tea disappear when the samples are powdered before extraction. Hence it is concluded that rolling has the effect of increasing easily soluble matter by crushing the cells and pressing out the juice so that it dries on the surface of the leaves.

III.—*Effect of firing on the chemical composition of tea.*—Refiring improves the flavour and colour of both green and black tea. Experiments were made with samples of tea fired at different temperatures for different periods. It was found that the optimum condition for firing green tea is a temperature of 70°C*. for one hour and for black tea a temperature of 80°C*. Higher temperatures spoil both flavour and colour. The solubility increases slightly at moderate temperatures, but at higher temperatures the total soluble substance and tannin decrease remarkably. The tannin is destroyed by oxidation and a decrease of caffeine takes place owing to volatilisation.

* 70°C.=158°F.
80°C.=175°F.

G. O. P.—1100—1-7-1915.